Course's Name analog communication
Course's Number :
Exam's Period :1hours
Questions' Number :
Total Mark :30
Pages' Number :

Palestine Technical University - Kadoorie



first......Exam
second......Semester 2012/2013

Instructor's Name :Mahmoud Ahmad
Student's Name:
Student's Numbe
Section's Numbe.
Exam's Date :20
Form :

28/30

Analog Comm 1st Exam

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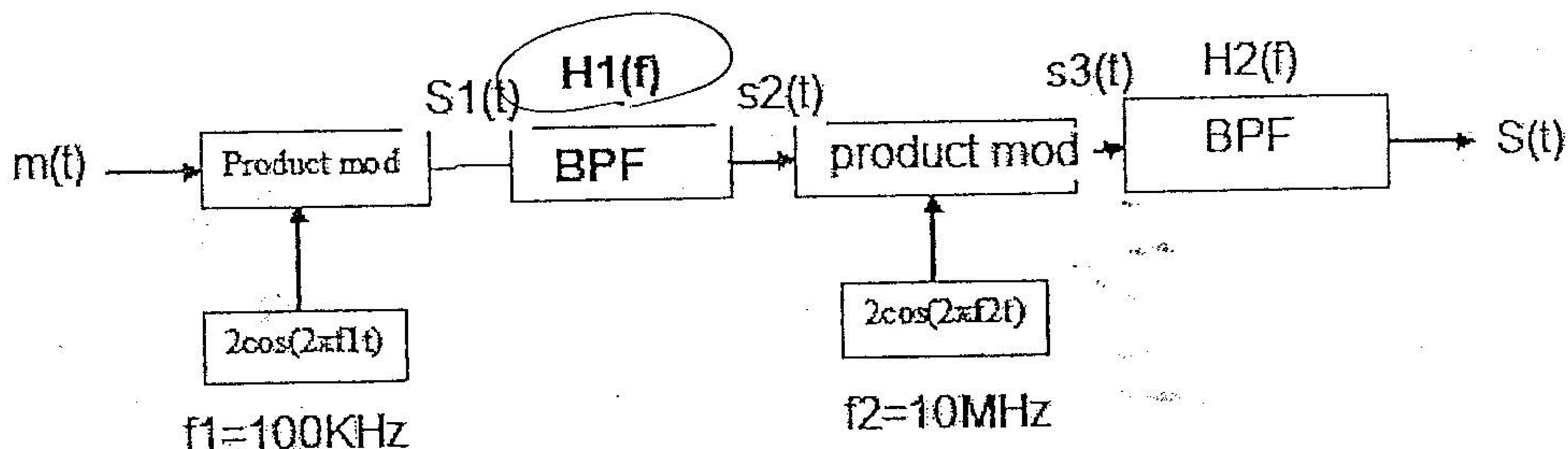
Q1)(part1) Consider a base band signal m(t) having a spectrum as shown below is the input of the modulator below.

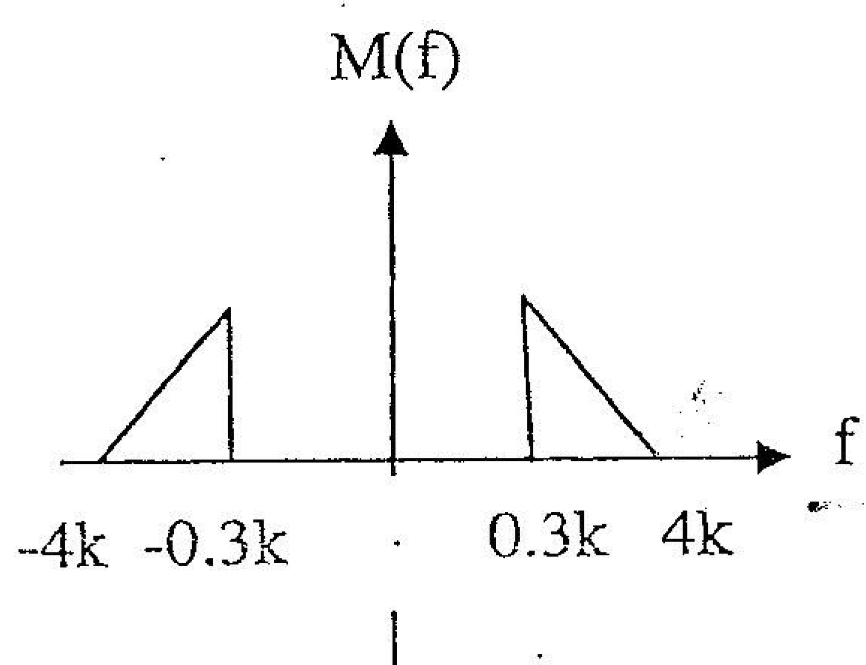
a)draw the spectrum of S1(t) (1)

b)draw the amplitude spectrum of the BPF H1(f) to obtain a SSB-USB modulated signal at its output and draw the spectrum of S2(t) (2)

c)draw the spectrum of S3(t) (1)

d)Draw the amplitude spectrum of BPF2 to obtain SSB-USB at its output and draw the spectrum of S(t) (2)





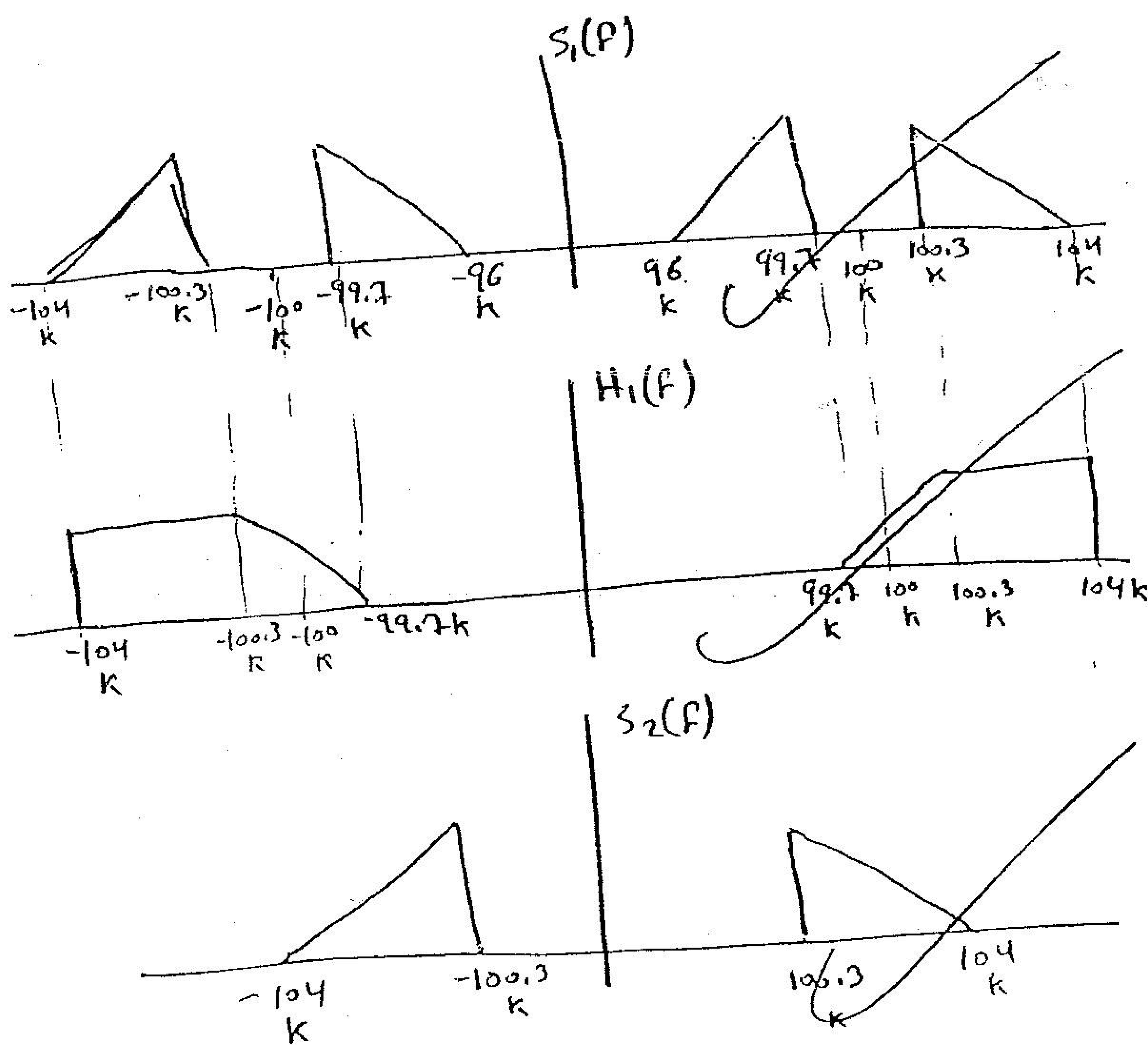
$s_1(t) = m(t)\cos 2\pi f_1 t$

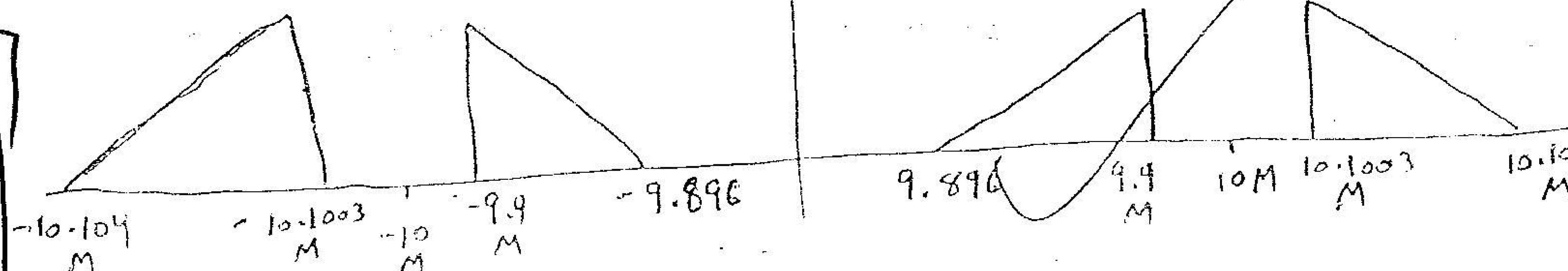
$s_3(t) = s_2(t)\cos 2\pi f_2 t$

اتصالات تماثلية
تخصص اتصالات
الامتحان الأول

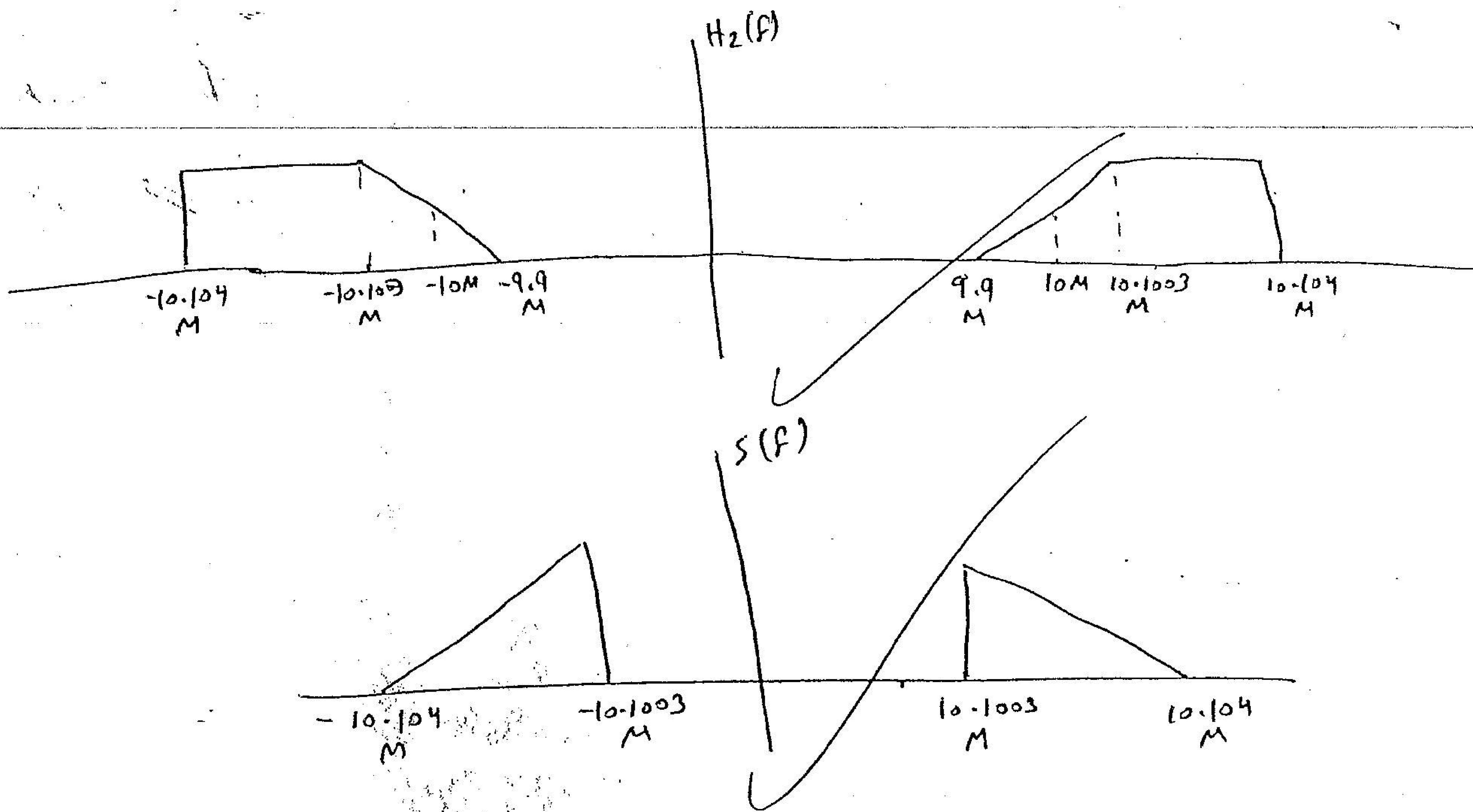
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تم الرفع بواسطة
م. معن أبو عيسى





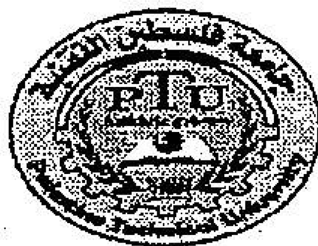
page 1



$H_2(f)$
-10.104 M
-10.1003 M
-10M
-9.9 M
9.9 M
10M
10.1003 M
10.104 M
S(f)
- 10.104 M
-10.1003 M
10.1003 M
10.104 M

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(5)

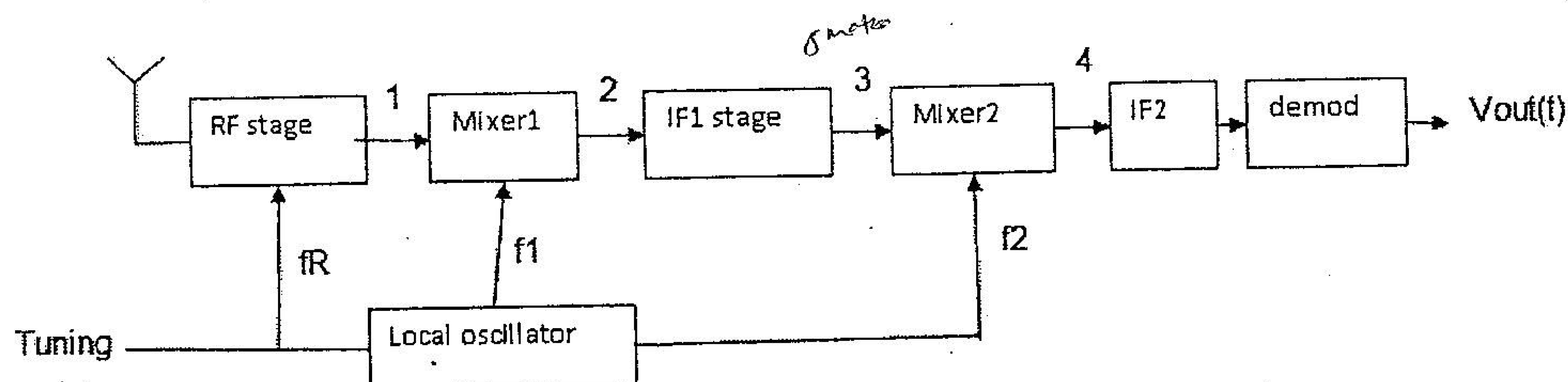
Q1)(part 2)The modulated signal in part1 is the input of the following superhetrodyne receiver

a)What is the value of fr draw the spectrum at 1 (1)

b)What is the value of f1 such that the frequency in IF1 stage is 5MHz draw the spectrum of the filter at the IF1 stage (2)

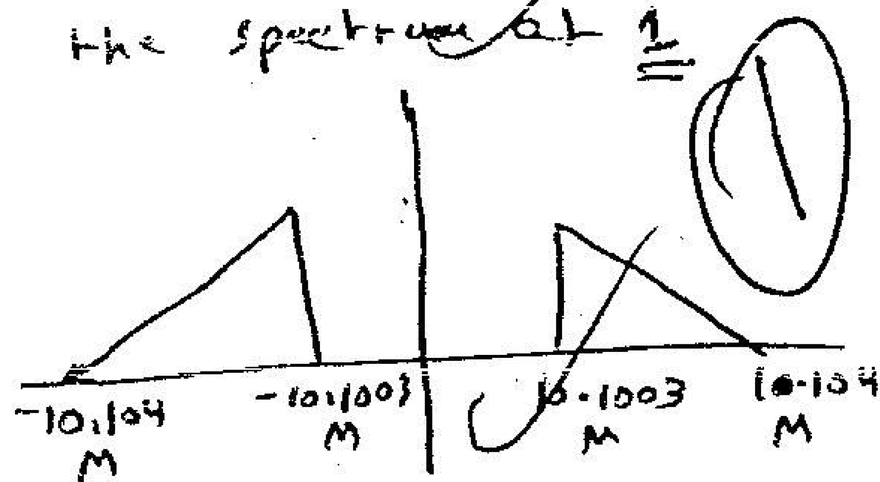
c)What is the value of f2 such that the frequency in IF2 is 0.455MHz draw the spectrum at the output of IF2 stage (2)

d)Draw the block diagram of a demodulator to obtain m(t) at the output , what is the carrier frequency of the oscillator at the demodulator .Show that the output of the demodulator is m(t) (2)



(a) $f_r = 10MHz$

the spectrum at 1



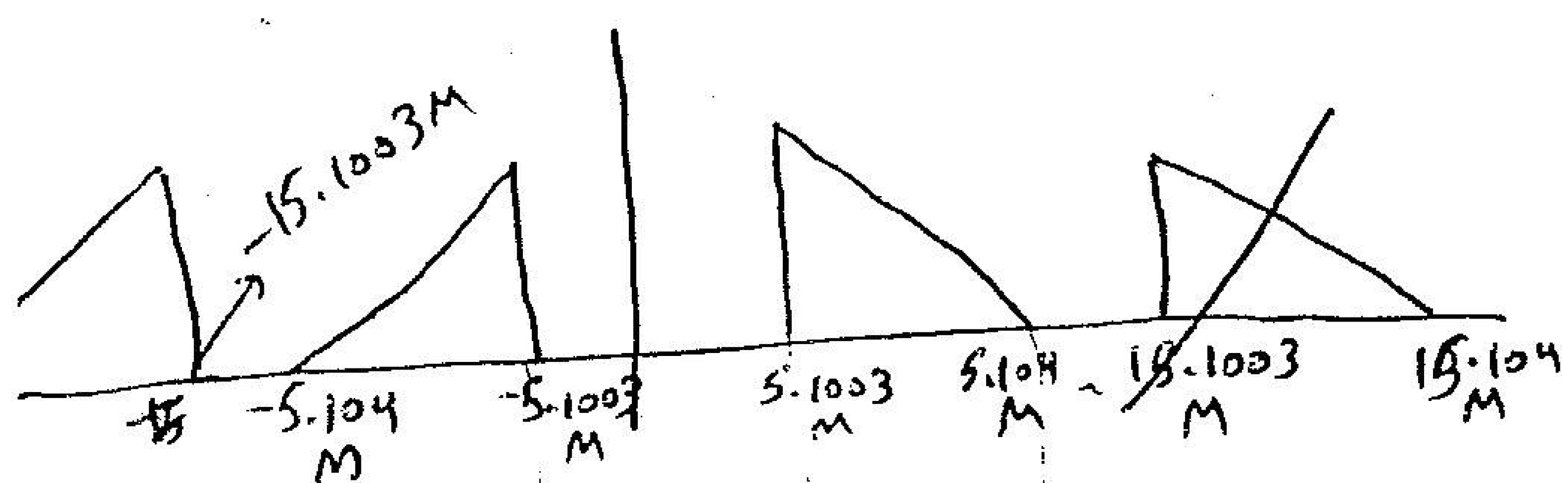
(1)

(b) $f_R - f_1 = 5MHz$

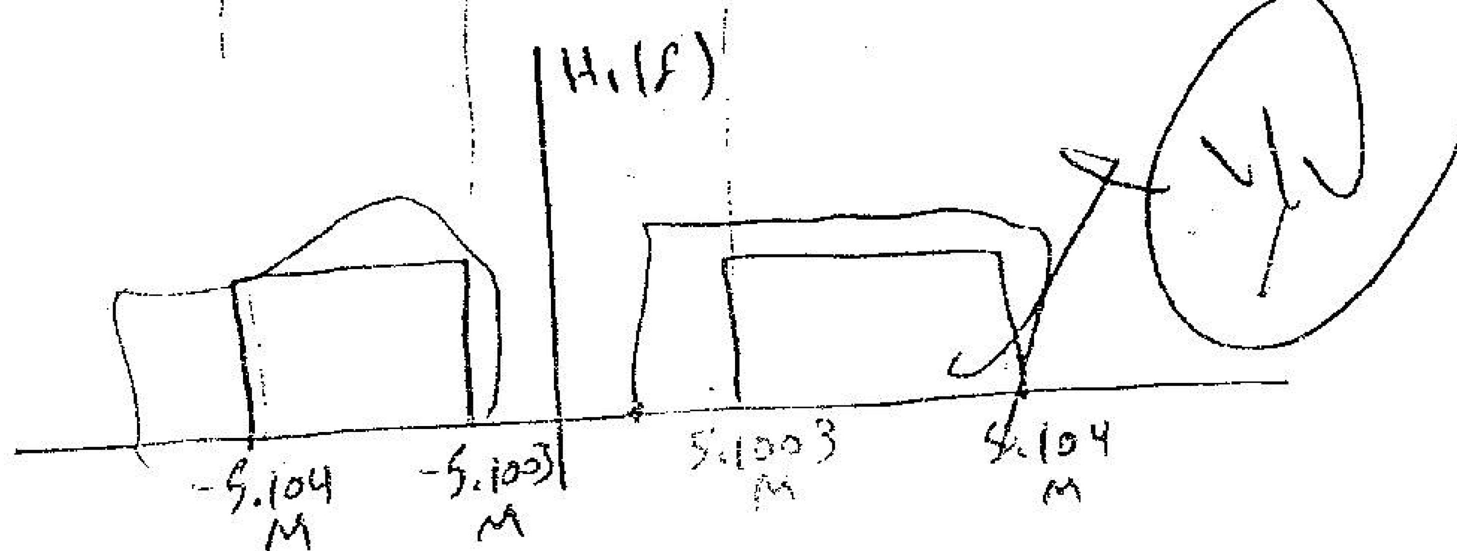
$10M - f_1 = 5MHz$

$f_1 = 5MHz$

(1)



the spectrum at 2

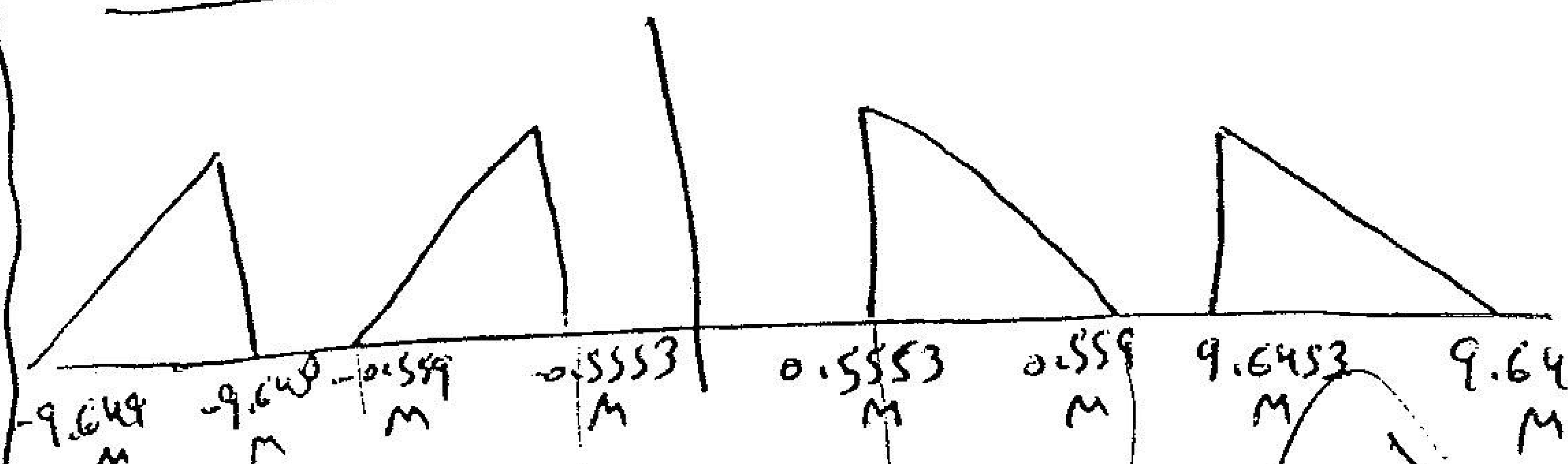


the spectrum at 3



$F_{IF_1} - f_2 = 0.455MHz$

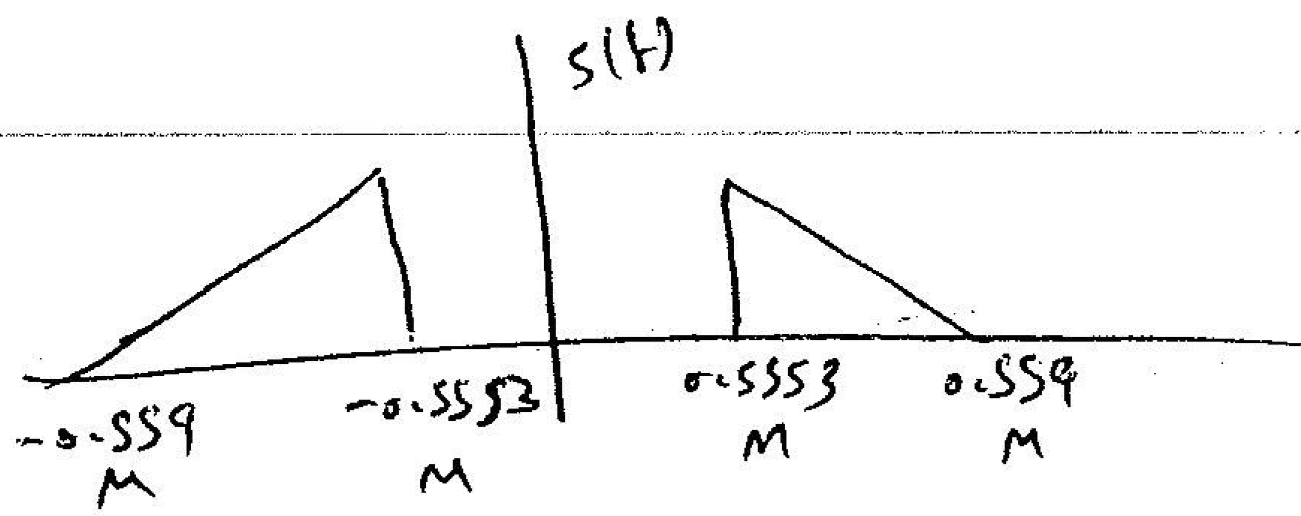
$f_2 = 5MHz - 0.455M = 4.545MHz$



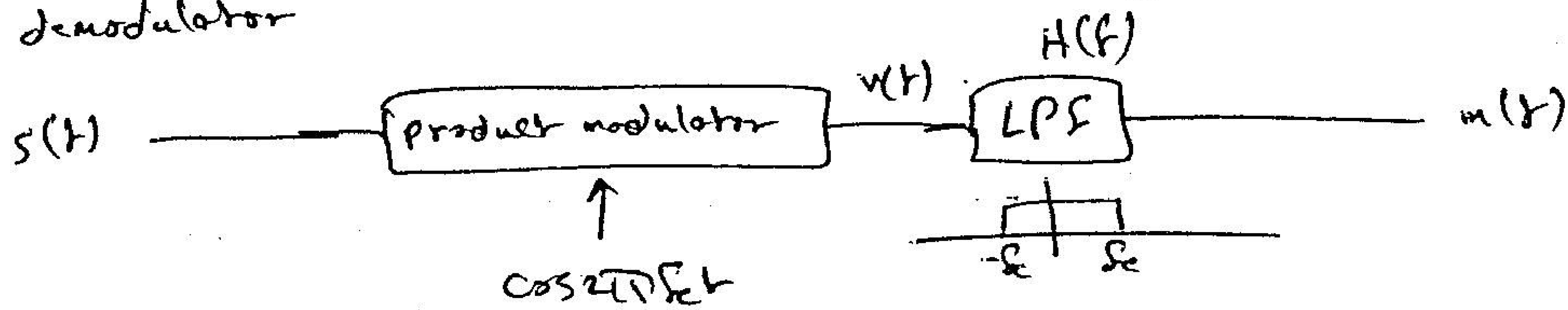
the spectrum at 4



after H_2

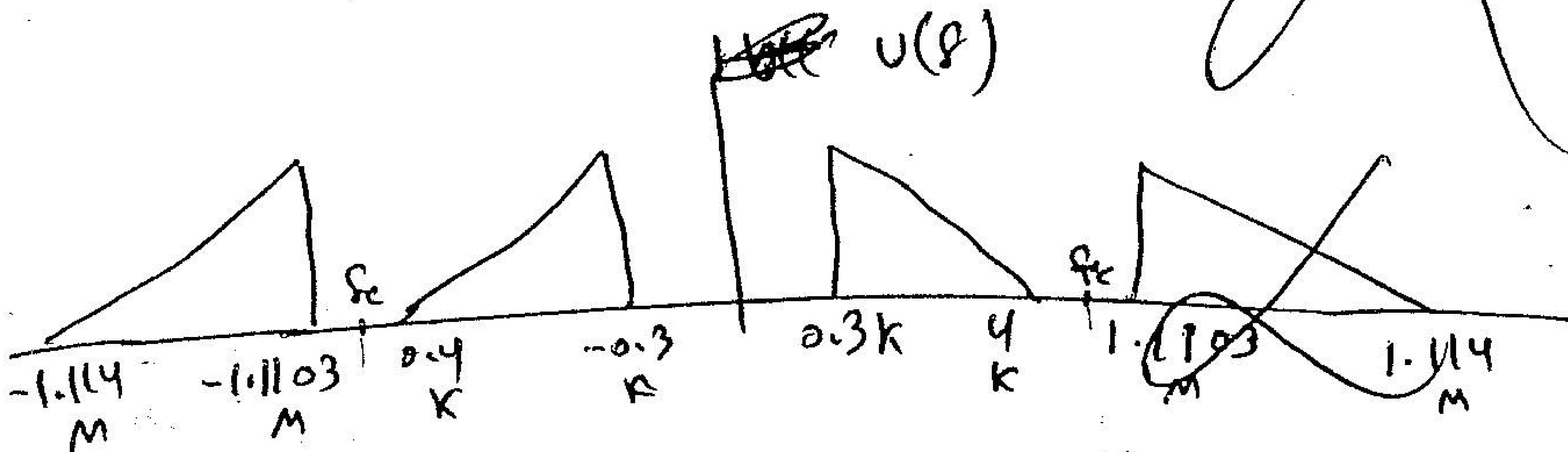


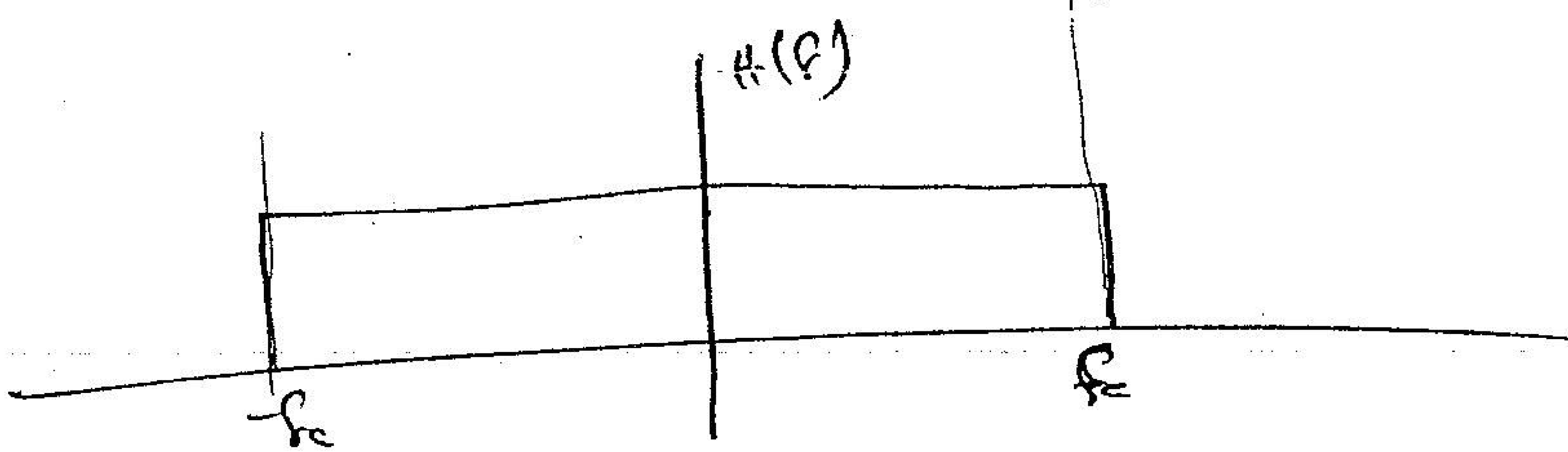
the demodulator



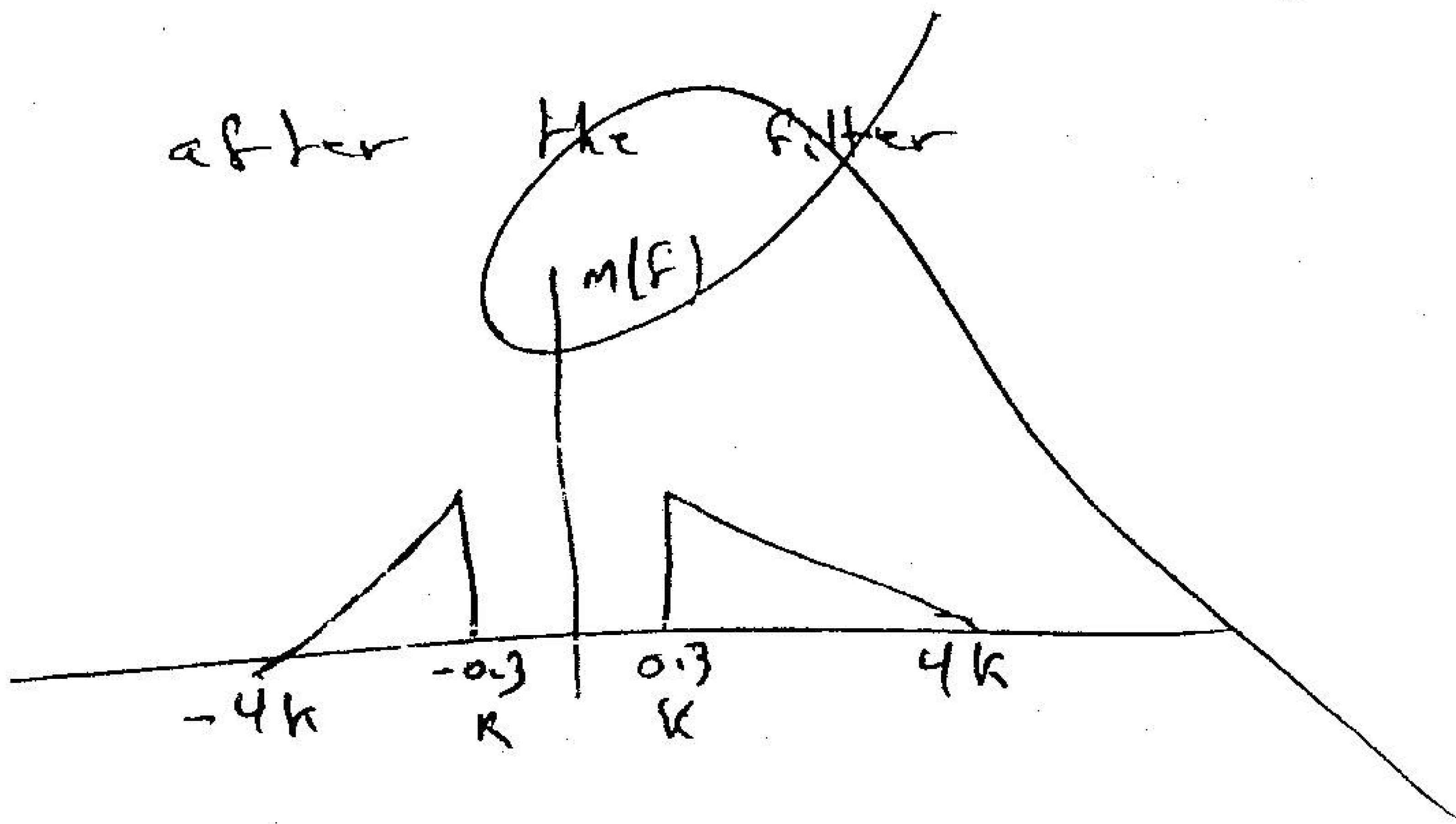
fc must be 0.555 M Hz

$v(t) = s(t) \cos 2\pi f_c t$ with fc = 0.555 M Hz





after the filter



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Q2) (9 marks)Consider a modulating wave

$$m(t) = 2\cos(2\pi * 10^3\, t) + 2\cos(2\pi * 5 * 10^3\, t)$$ and a carrier wave

$$c(t) = \cos(2\pi * 100 * 10^3\, t)$$

Assuming that the modulator have an amplitude sensitivity of 0.4

a)Write the time expression for the AM modulated wave (1)

b)What is the modulating factor for the modulator and what is the percent modulation (1)

d)Find and draw the spectrum of the modulated wave . (3)

e)Find the total power of the side bands and the total power of the carrier and hence find P_{sb}/P_T (2)

f)Suggest a demodulator for this system to recover the base band signal from the incoming wave and draw the block diagram for such demodulator . (1)

g)In your opinion what are the disadvantages of AM modulation (1)

h)Draw the block diagram to generate the carrier from the incoming wave. (1)

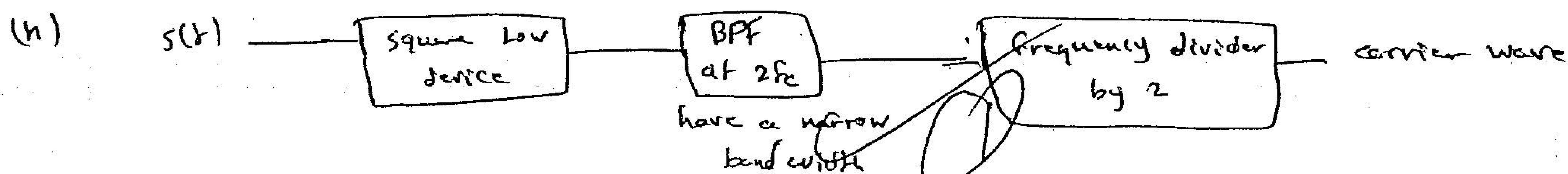
(a) $s(t) = A_c\,[1 + K_a\, m(t)] \cos 2\pi f_c t$

$s(t) = [1 + 0.8\,[\cos 2\pi * 10^3 t + \cos 2\pi * 5 * 10^3 t]] \cos 2\pi * 100 * 10^3 t$ 1

(b) $\mu = K_a A_m = 0.4 * 2 = 0.8$

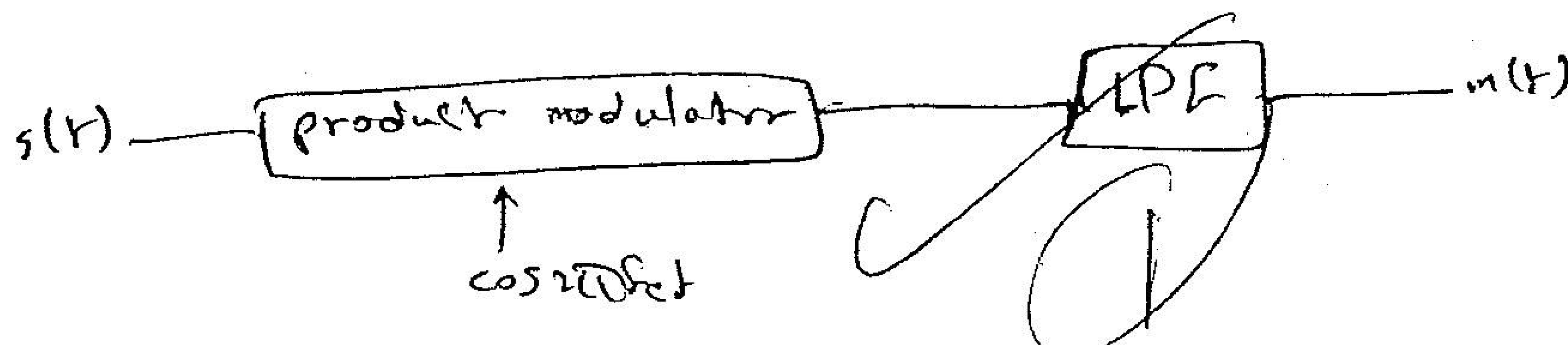
percent modulation = $|K_a m(t)| * 100$ = 0.8 * 100 = 80% 1

(g) the disadvanteges of AM modulation is waste of power and wese of Band width 1



1

(f) the demodulator is coherent detector



C 1

$m(t) = 2\cos 2\pi * 10^3 t + 2\cos 2\pi * 5*10^3 t$

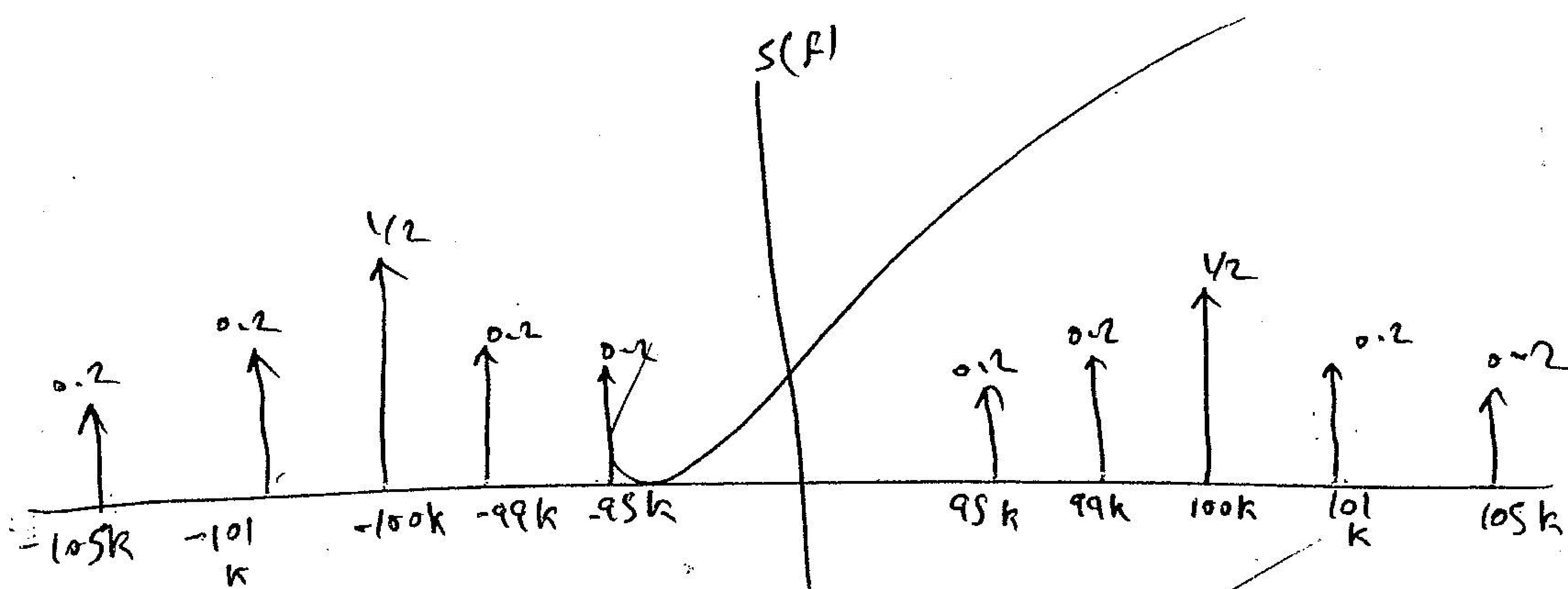
$c(t) = \cos 2\pi * 100 * 10^3 t$

$s(t) = \left[1 + 0.8 \left[\cos 2\pi * 10^3 t + \cos 2\pi * 5 * 10^3 t \right] \right] \cos 2\pi * 100 * 10^3 t$

$= \cos 2\pi * 100 * 10^3 t + 0.8 \cos 2\pi * 10^3 t \cos 2\pi * 100 * 10^3 t + 0.8 \cos 2\pi * 5 * 10^3 t \cos 2\pi * 100 * 10^3 t$

$= \cos 2\pi * 100 * 10^3 t + 0.4 \left[\cos 2\pi * 99 * 10^3 t + \cos 2\pi * 101 * 10^3 t \right]$

$+ 0.4 \left[\cos 2\pi * 95 * 10^3 t + \cos 2\pi * 105 * 10^3 t \right]$

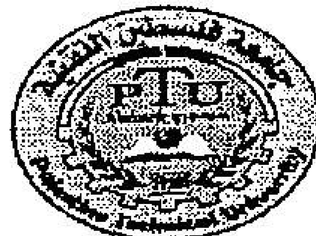


$P_{sb} = (0.2)^2 * 8 = 0.32$

$P_T = P_{sb} + P_{carrier} = 0.32 + (0.5)^2 * 2 = 0.82$

~~0.32 +~~

$\frac{P_{sb}}{P_T} = \frac{0.32}{0.82} = 0.39$

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Q3)a)SSB modulation is not suitable for image transmission why? (1)

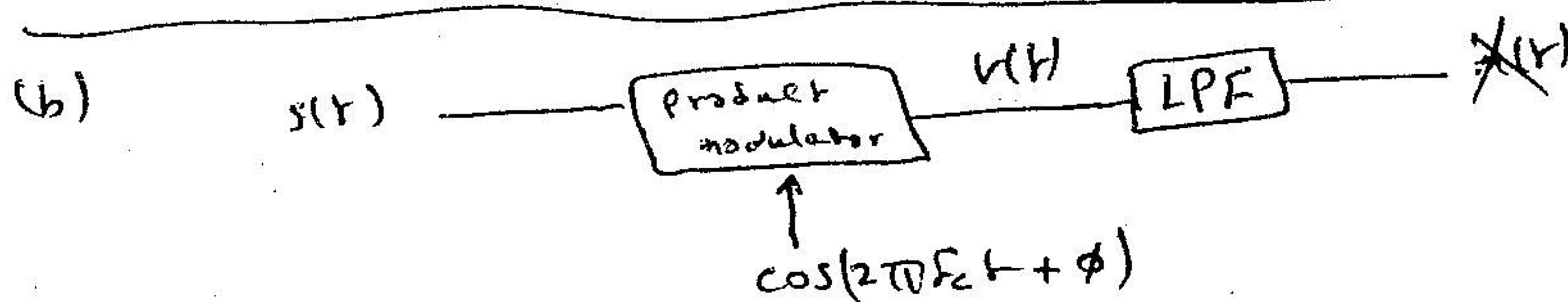
b)In using coherent detector in SSB modulation there must be full synchronization in both phase and frequency between the incoming signal and the local oscillator used explain in detail the effect of the phase and frequency error on the incoming wave . (3)

c)Draw the block diagram for the VSB modulator and write the specifications of the filter used . (2)

d)Draw the block diagram for a suitable demodulator for VSB modulation (1)

(a) because the image contains very low frequencies and we can't separate the upper side band from the lower side band.

(b)



Let take SSB - USB

$s(t) = \frac{1}{2} A_c m(t) \cos 2\pi f_c t - \frac{1}{2} A_c \hat{m}(t) \sin 2\pi f_c t$

$v(t) = \frac{1}{2} A_c m(t) \cos 2\pi f_c t \cos(2\pi f_c t + \phi) - \frac{1}{2} A_c \hat{m}(t) \sin 2\pi f_c t \cos(2\pi f_c t + \phi)$

$= \frac{1}{4} A_c m(t) [\cos\phi + \cos(4\pi f_c t + \phi)] - \frac{1}{4} A_c \hat{m}(t) [-\sin\phi + \sin(2\pi f_c t + \phi)]$

2

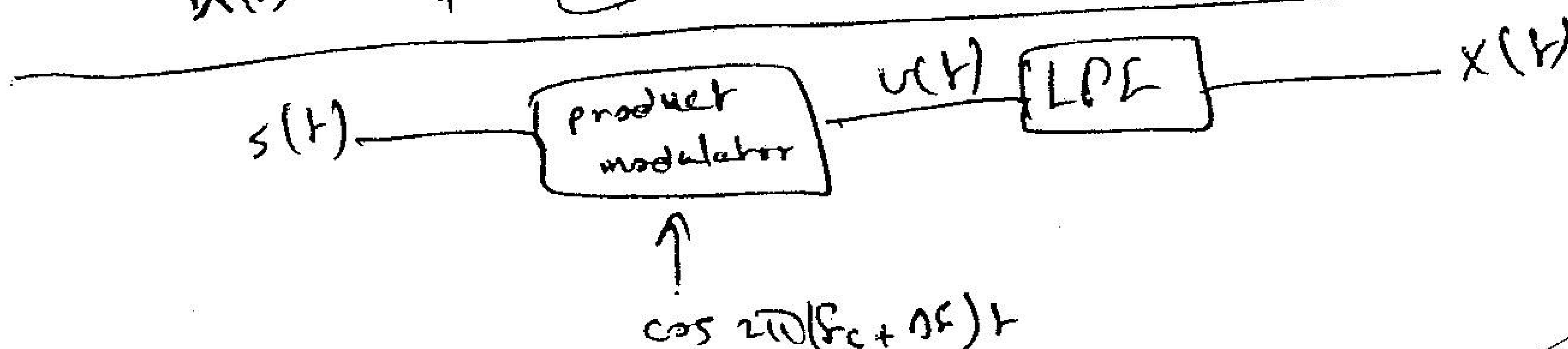
after the LPF

$x(t) = \frac{1}{4} A_c m(t) \cos\phi + \frac{1}{4} A_c \hat{m}(t) \sin\phi$

$X(f) = \frac{1}{4} A_c \cos\phi \, M(f) + \frac{1}{4} A_c \sin\phi (-j \, \text{sgn}(f)) M(f)$ for $f > 0$.

$= \frac{1}{4} A_c M(f) [\cos\phi - j \sin\phi]$

$x(t) = \frac{1}{4} A_c M(t) e^{-j\phi}$



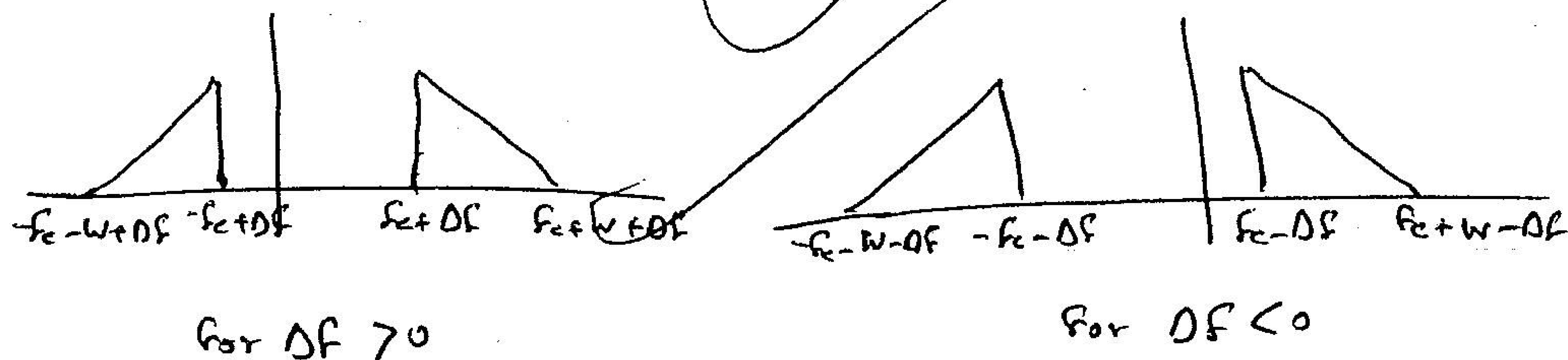
Let take SSB-USB

$v(t) = \frac{1}{2} A_c m(t) \cos 2\pi f_c t \cos 2\pi(f_c + \Delta f)t - \frac{1}{2} A_c \hat{m}(t) \sin 2\pi f_c t \cos 2\pi(f_c + \Delta f)$

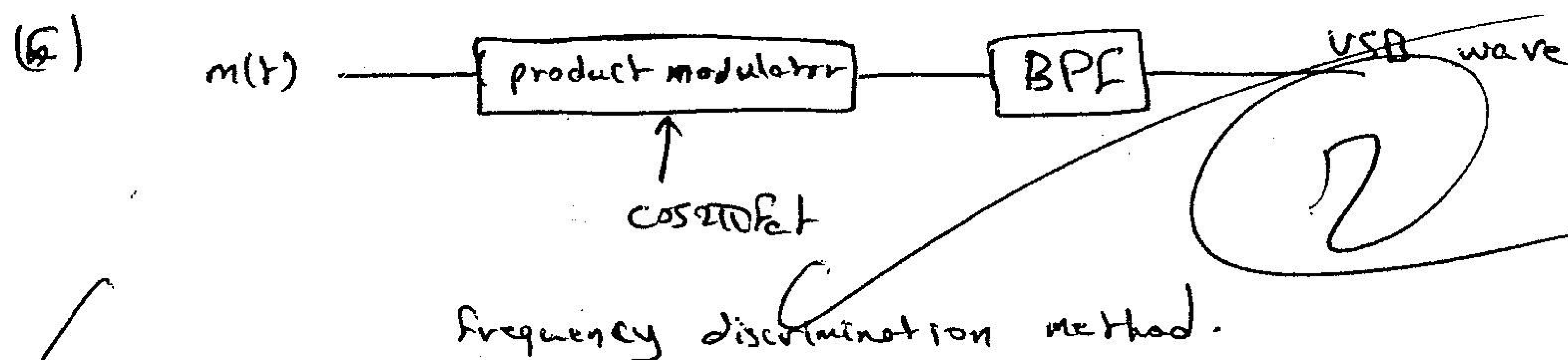
$= \frac{1}{4} A_c m(t) [\cos 2\pi \Delta f t + \cos(4\pi f_c t + 2\pi \Delta f t)]$

$- \frac{1}{4} A_c \hat{m}(t) [+\sin 2\pi \Delta f t + \sin(4\pi f_c t + 2\pi \Delta f t)]$

$x(t) = \frac{1}{2} A_c m(t) \cos 2\pi \Delta f t + \frac{1}{2} A_c \hat{m}(t) \sin 2\pi \Delta f t$

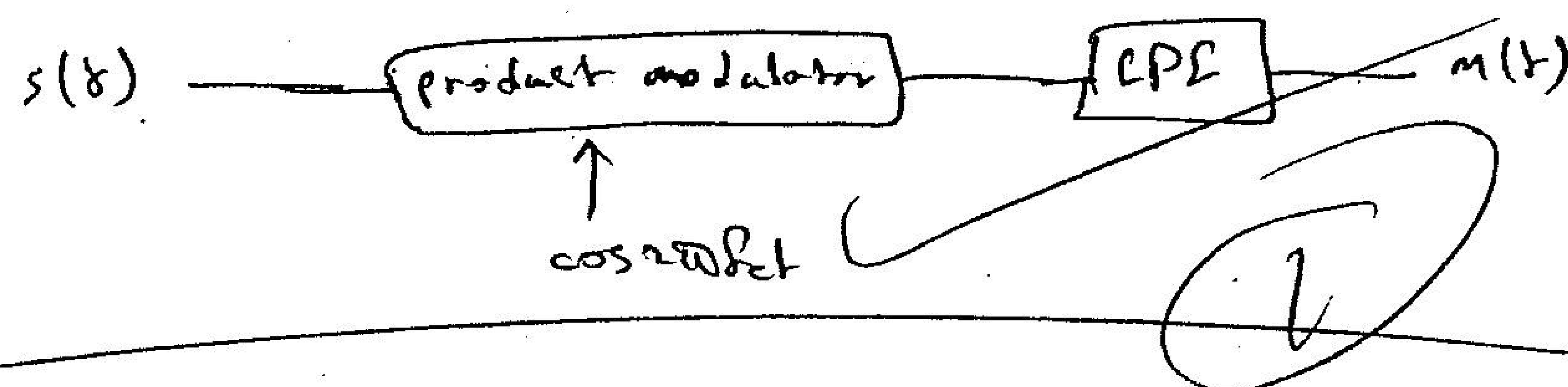


(c)



frequency discrimination method.

(d) the demodulator of VSB is synchronous detector



the specifications of the filter

$s(t) = \frac{1}{2} A_c m(t) \cos 2\pi f_c t \; H(f)$

$[H(f-f_c) + H(f+f_c)]$ must be constant